PERSONALIZED MEDICINE FOR IN-VITRO FERTILIZATION USING COMPUTATIONAL MODELING AND OPTIMAL CONTROL

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Abstract Body

The success of IVF depends upon successful superovulation, defined by the number and uniformly high quality of eggs retrieved in a cycle. The daily dosage of hormones required for this stage, is customized for each patient based on almost daily ultrasound and blood test. Although there are the general guidelines for dosage, the dose is not optimized for each patient, and complications, such as overstimulation, can occur. The cost of testing and drugs make this stage very expensive. To overcome these shortcomings, a mathematical procedure and software is developed which can provide a customized model of this stage regarding the size distribution of follicles (FSD) obtained per cycle as a function of the drug dosage used. Customized optimal drug dosage procedures are developed for each patient using optimal control methods with the targeted FSD. This paper describes the theory, model, and the optimal control procedure for improving outcomes of IVF treatment for one of the four protocols used in real practice. The validation of the procedure is performed using clinical data from the 49 patients' previously undergone IVF cycles. Customized patient-specific model parameters are obtained by using initial two-day data for each patient and are used to predict the customized optimal drug dosage for each patient. A small double-blind clinical trial with 10 patients was also conducted in India. The results from the trial show that the dosage predicted by using the model is 40 % less than the suggestion made by the IVF doctors. Additionally, the number of mature follicles obtained at the end of the cycle using the model-predicted dosage was significantly higher than the physician suggested dosage. The testing and monitoring requirements for patients using optimized drug dosage is reduced by 72%.